C1 Cont Sub D6

110. (Amended) A method according to claim 29, further comprising a step of forming a semiconductor layer containing an impurity on the transferred semiconductor layers.

REMARKS

This application has been carefully reviewed in light of the Office Action dated December 19, 2001 (paper no. 8). Claims 29, 52 to 67, 82, 83, 85, 86, 88, 94, 95, 97 to 110 are pending, of which Claims 82, 83, 85 and 86 have been withdrawn from consideration pursuant to a constructive election. Claims 29, 52, 57, 82 and 85 are independent. Reconsideration and further examination are respectfully requested.

Claims 1, 3, 6, 7, 20, 21, 23, 26, 27, 30, 39 to 51, 84, 89 to 91 and 93 were rejected under 35 U.S.C. § 103(a) over U.S. Patent No. 5,536,361 (Kondo), U.S. Patent No. 5,811,348 (Matsushita), U.S. Patent No. 5,371,037 (Yonehara), U.S. Patent No. 5,277,748 (Sakaguchi '748) or U.S. Patent No. 5,492,859 (Sakaguchi '859) in view of U.S. Patent No. 4,236,947 (Baliga); and Claims 11 to 18, 31 to 38 and 96 were rejected under 35 U.S.C. § 103(a) over the same references and further in view of U.S. Patent No. 5,391,257 (Sullivan). These claims have been cancelled without prejudice or disclaimer of subject matter, and without conceding the correctness of their rejection, strictly as an expedient to advance this case to allowance more quickly.

Claims 29, 52 to 57, 60 to 67, 88 and 102 to 110 were rejected under 35 U.S.C. § 103(a) over Kondo, Matsushita, Yonehara, Sakaguchi '748 or Sakaguchi '859 in

view of Baliga.[1] Claims 58 and 59 were rejected under 35 U.S.C. § 103(a) over the above references and further in view of U.S. Patent No. 4,774,194 (Hokuyou). Claims 94, 95 and 97 to 101 were rejected under 35 U.S.C. § 103(a) over the above references and further in view of Sullivan. The rejections are respectfully traversed.

The present invention, as recited by Claim 29, concerns a method of producing a solar cell. A porous layer is formed in a surface region of a first substrate. A first semiconductor layer is formed on the porous layer by liquid phase epitaxy under a reducing atmosphere. A second semiconductor layer is formed on the first semiconductor layer by liquid phase epitaxy. The first substrate is bonded to a second substrate to obtain a multiple layer structure with the second semiconductor layer positioned inside. The first substrate is separated from the multiple layer structure by utilizing the porous layer to transfer the first and second semiconductor layers to the second substrate. In the liquid phase epitaxy used to form the first semiconductor layer, a melting solution in which elements for forming the first semiconductor layer are dissolved up to a desired concentration is brought into contact with a surface of the porous layer while a surface temperature of the porous layer is made lower than a temperature at which elements in the melting solution having the desired concentration are saturated by at least 5 degrees Celsius. The surface of the porous layer is annealed under a reducing atmosphere in advance.

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[1]/The Office Action includes Claims 82, 83, 85 and 86 in the list of rejected claims. However, these claims were withdrawn from consideration as being directed to a non-elected invention in the Office Action dated March 3, 2001 (paper no. 6). Accordingly, Applicants are not treating these claims as being rejected.

The invention, as recited by Claim 52, concerns a method of producing a semiconductor member. A porous layer is formed in a surface region of a first substrate. The porous layer is immersed into a melting solution in which elements for forming a first semiconductor layer to be grown are dissolved up to a supersaturated state or a substantially supersaturated state, while the melting solution has a temperature that is lower than a temperature at which the elements in the melting solution are saturated by at least 5 degrees Celsius, under a reducing atmosphere to grow the first semiconductor layer on a surface of the porous layer. A second semiconductor layer is formed on the first semiconductor layer by liquid phase epitaxy. A second substrate is bonded onto a surface side of the first substrate on which at least the porous layer and the first semiconductor layer are formed. The first substrate is then separated from the second substrate at the porous layer to transfer the first and second semiconductor layers to the second substrate.

The invention, as recited by Claim 57, concerns a method of producing a semiconductor member. A porous layer is formed in a surface region of a first substrate. The porous layer is immersed into a melting solution in which elements for forming a first semiconductor layer to be grown are dissolved up to a desired concentration, under a reducing atmosphere to grow the first semiconductor layer on a surface of the porous layer. The surface temperature of the porous layer is made lower than a temperature at which the melting solution is saturated by at least 5 degrees Celsius. A second semiconductor layer is formed on the first semiconductor layer by liquid phase epitaxy. A second substrate is bonded onto a surface side of the first substrate, and the first substrate is separated from the

second substrate at the porous layer to transfer the first and second semiconductor layers from the first substrate to the second substrate.

Thus, according to one feature of the invention recited by Claims 29 and 57, the surface temperature of the porous layer is made lower than the temperature at which the melting solution is saturated by at least 5 degrees Celsius. By virtue of this feature, an easily separable, high-crystalline semiconductor layer can be formed. See Experiment 3 and Table 2 of the specification. Similar benefits are achieved when, as recited by Claim 52, the melting solution temperature is lower than its saturation temperature by at least 5 degrees Celsius. See Experiment 2 and Table 1 of the present specification.

The Office Action conceded that all of Kondo, Matsushita, Yonehara, Sakaguchi '748 and Sakaguchi '859 failed to disclose at least these features. Although reliance was placed on Baliga for these features, it is Applicants' position that Baliga also fails to teach or disclose at least these features.

According to Baliga, if the melting solution is initially saturated, the silicon substrate wafer should be heated to a temperature above that of the saturation temperature, in order to promote meltback of the wafer. For example, in the embodiment described at col. 3, line 51 to col. 4, line 10 of Baliga, the tin melt is saturated at 950° C, and the wafer is heated to 955° C. Thus, the teaching of Baliga is exactly opposite to that of the present invention according to Claims 29 and 57, in which the porous layer has a temperature that is lower than the saturation temperature by at least 5 degrees.

Baliga also discloses that the melting solution may be initially undersaturated in order to promote meltback. For example, at col. 4, line 44, Baliga states

that the melting solution may be undersaturated by 5 degrees, meaning that the melting solution temperature is 5 degrees higher than its saturation temperature. This teaching is exactly opposite to that of the present invention according to Claim 52, in which the melting solution has a temperature 5 degrees lower than its saturation temperature.

The deficiencies of Baliga are not remedied by Kondo, Matsushita, Yonehara, Sakaguchi '748, Sakaguchi '859, Hokuyou, Sullivan or any of the applied references. Applicants therefore conclude that all of these references do not teach or suggest the claimed invention either singly or in the combination proposed by the Office Action, even assuming that such combination can properly be made. It is therefore respectfully requested that the Section 102 and 103 rejections be withdrawn and that non-elected Claims 82, 83, 85 and 86 be re-joined.

In view of the foregoing amendments and remarks, Applicants respectfully request favorable reconsideration and a Notice Of Allowance.

Applicants' undersigned attorney may be reached in our Costa Mesa, California office at (714) 540-8700. All correspondence should continue to be directed to our below-listed address.

Respectfully submitted,

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APPENDIX

VERSION WITH MARKINGS TO SHOW CHANGES MADE TO CLAIMS

29. (Three Times Amended) A method of producing a solar cell comprising the steps of:

forming a porous layer in a surface region of a first substrate;

forming a first semiconductor layer on the porous layer by liquid phase epitaxy under a reducing atmosphere;

forming a second semiconductor layer on the first semiconductor layer by liquid phase epitaxy;

bonding the first substrate to a second substrate to obtain a multiple layer structure with the second semiconductor layer positioned inside; and

separating the first substrate from the multiple layer structure by utilizing the porous layer to transfer the first and second semiconductor layers to the second substrate;

wherein in the liquid phase epitaxy [includes that] used to form the first semiconductor layer, a melting solution in which elements for forming the first semiconductor layer [to be grown] are dissolved up to a desired concentration [is used and the melting solution] is brought [in] into contact with a surface of the porous layer which is annealed under a reducing atmosphere in advance, while a surface temperature of the

porous layer is made lower than a temperature at which elements in the melting solution having the desired concentration are saturated by at least 5 degrees Celsius.

52. (Twice Amended) A method of producing a semiconductor member comprising the steps of:

(a) forming a porous layer in a surface region of a first substrate;

(b-1) immersing the porous layer into a melting solution in which elements for forming a first semiconductor layer to be grown [is] are dissolved up to a supersaturated state or a substantially supersaturated state, while the melting solution has a temperature that is lower than a temperature at which the elements are saturated by at least 5 degrees Celsius, under a reducing atmosphere to grow the first semiconductor layer on a surface of the porous layer;

(b-2) forming a second semiconductor layer on the first semiconductor layer by liquid phase epitaxy;

(c) bonding a second substrate onto a surface side of the first substrate on which at least the porous layer and the first semiconductor layer are formed; and

(d) separating the first substrate from the second substrate at the porous layer to transfer the first and second semiconductor layers separated from the first substrate to the second substrate.

54. (Amended) A method of producing a semiconductor member according to claim [52] 53, wherein after [a] the surface of the first substrate separated in the step (d) is treated and before it is again subjected to the step (a), a semiconductor layer into which an impurity is introduced by liquid phase growth is allowed to grow on the surface of the first substrate[, and then again subjected to the step (a) as the first substrate].

55. (Amended) A method of producing a semiconductor member according to claim 54, wherein after the surface of the first substrate separated in the step (d) is treated and prior to the [formation] growth of the semiconductor layer [in] into which the impurity is introduced, a semiconductor layer into which no impurity is introduced or into which an impurity is introduced with a small concentration is formed on the surface of the first substrate [after being subjected to the surface treatment].

56. (Amended) A method of producing a semiconductor member according to claim 54, wherein a semiconductor having a purity of 99.99% or less is used as the first substrate.

57. (Amended) A method of producing a semiconductor member comprising the steps of:

(a) forming a porous layer in a surface region of a first substrate;

(b-1) immersing, into a melting solution in which elements for forming a first semiconductor layer to be grown [is] are dissolved up to a desired concentration, the porous layer, whose surface temperature is made lower than a temperature at which the melting solution having the desired concentration is saturated by at least 5 degrees Celsius, under a reducing atmosphere to grow the first semiconductor layer on a surface of the porous layer [under a reducing atmosphere];

(b-2) forming a second semiconductor layer on the first semiconductor layer by liquid phase epitaxy;

(c) bonding a second substrate onto a surface side of the first substrate on which at least the porous layer and the first semiconductor layer are formed; and

(d) separating the first substrate from the second substrate at the porous layer to transfer the first and second semiconductor layers separated from the first substrate to the second substrate.

59. (Amended) A method of producing a semiconductor according to claim [57] 58, wherein after [a] the surface of the first substrate separated in the step (d) is treated and before it is again subjected to the step (a), a semiconductor layer into which an impurity is introduced by liquid phase growth is allowed to grow on the surface of the first substrate[, and the again subjected to the step (a) as the first substrate].

60. (Amended) A method of producing a semiconductor material according to claim 59, wherein after the surface of the first substrate in the step (d) is treated and prior to the [formation] growth of the semiconductor layer [in] into which the impurity is introduced, a semiconductor layer into which no impurity is introduced or into which an impurity is introduced with a small concentration is formed on the surface of the first substrate [after being subjected to the surface treatment].

61. (Amended) A method of producing a semiconductor material according to claim 59, wherein a semiconductor having a purity of 99.99% or less is used as the first substrate.

64. (Amended) A method of producing a solar cell, comprising a step of using the semiconductor [layer] layers transferred to the second substrate which [is] are obtained by the method of claim 52.

67. (Amended) A method of producing a solar cell, comprising a step of using the semiconductor [layer] layers transferred [onto] to the second substrate which [is] are obtained by the method of claim 57.

97. (Amended) A method according to claim [96] 29, further comprising a step of separating the second substrate to transfer the semiconductor [layer] layers onto [the] a third substrate.

102. (Amended) A method according to claim 29, wherein an impurity in the porous layer is diffused into the first semiconductor layer.

103. (Amended) A method according to claim 29, wherein the liquid phase epitaxy for forming the first semiconductor layer is conducted with indium as a solvent.

104. (Amended) A method according to claim 29, wherein before bonding of the second substrate, an impurity is introduced into one or both of the semiconductor [layer] layers.

105. (Amended) A method according to claim 29, wherein before the bonding of the second substrate, an impurity is introduced into one or both of the semiconductor [layer] layers to form a p-n junction.

107. (Amended) A method according to claim 29, further comprising a step of removing the porous layer remaining on the transferred first semiconductor layer.

108. (Amended) A method according to claim 29, further comprising a step of forming an electrode on the transferred semiconductor [layer] layers.

109. (Amended) A method according to claim 29, further comprising a step of introducing an impurity into one or both of the transferred semiconductor [layer] layers.

110. (Amended) A method according to claim 29, further comprising a step of forming a semiconductor layer containing an impurity on the transferred semiconductor [layer] layers.